

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
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SUBJECT: Keystone Sanitation Landfill: Spray Irrigation Area Risks

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DATE: 10/26/2011

In support of a five-year review addendum, I have assessed the spray irrigation area at the Keystone site with respect to human health risk issues.

A risk assessment was performed for the 1990 ROD, but risk assessment methodology, exposure assumptions, and toxicity factors have changed considerably since then. Therefore, this memo includes a reevaluation of risk.

The general conclusions of that risk reevaluation are summarized below:

- The reported concentrations of soil VOCs were below levels of concern and are likely to be even lower now. Given the time that has passed since the sampling, and the fact that the locations on the map are approximate, there is uncertainty about whether the previous sample locations were truly representative.
- Only three metals were associated with potentially unacceptable risks for unrestricted use (i.e., future residential receptors): chromium, cobalt, and manganese. These are believed to be associated with background, although there is uncertainty associated with this conclusion, as a few surface concentrations of cobalt and manganese are higher than the rest of the samples.

More details about the risk reevaluation are provided here:

The spray irrigation soil has not been sampled since 1989. Although it would be preferable to work with more recent sampling data, the most likely chemicals of potential concerns for this area would be VOCs, given the site history. Their concentrations would be expected to decrease over time, so that if the original samples (surface and subsurface soil) were collected in appropriate and representative locations, those concentrations probably form a high-end estimate of current and future risks.

According to page 3-24 of the RI, sample locations SL-3 through SL-8 were associated with the spray irrigation area; this is consistent with page 5-5, which indicates six locations

associated with the spray irrigation area. Two samples, one at the surface and one at depth, were collected from each of the six locations. For comparison, the background sample locations were SL-19 through SL-21. The data were obtained from a combination of Table 5-1 of the RI (which listed maximums for all soil samples) and Appendix E (which showed individual sample results). The data were compared to residential soil RSLs from the June 2011 RSL table, at an HQ of 0.1 and a cancer risk of 1E-6, consistent with regional guidance. The maximum VOC concentrations were also compared to risk-based SSLs for migration to groundwater, also shown on the RSL table.

Twelve chemicals exceeded RSLs: benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, dibenz[a,h]anthracene, aluminum, antimony, arsenic, chromium, cobalt, iron, manganese, and mercury. Maximum concentrations were used as a conservative estimate and an initial risk step. Direct contact with soil (via the ingestion and dermal pathways) was evaluated for hypothetical child and adult residents, to assess baseline (unrestricted) use.

The ingestion assessment equation for soil exposure was from the EPA "RAGS A" guidance. The dermal assessment came from "RAGS E." Most of the default exposure assumptions were from the 1991 Standard Default Exposure Factors guidance, RAGS E, or the 1997 Exposure Factors Handbook. Overall, the exposure assumptions were:

	Child	Adult
Soil ingestion rate (mg/day)	200	100
Exposed skin surface area (cm ² /day)	2800	5700
Soil-to-skin adherence factor (mg/cm ²)	0.2	0.07
Exposure frequency (days/yr)	350	350
Exposure duration (yrs)	2 (age 0-2) 4 (age 2-6)	10 (age 6-16) 14 (age 16-30)
Body weight (kg)	15	70
Averaging time – cancer (days)	365 x ED	365 x ED
Averaging time – noncancer (days)	365 x 70	365 x 70

These toxicity factors were obtained, as indicated on the June 2011 RSL table:

Chemical	Oral/derm RfD (mg/kg/day)	Oral/derm CSF (1/mg/kg/day)
benz[a]anthracene	--	0.73
benzo[a]pyrene	--	7.3
benzo[b]fluoranthene	--	0.73
dibenz[a,h]anthracene	--	7.3
Al	1	--
Sb	4E-4/6E-5	--
As	3E-4	1.5
Cr	3E-3/7.5E-5	0.5/20
Co	3E-4	--
Fe	0.7	--

Chemical	Oral/derm RfD (mg/kg/day)	Oral/derm CSF (1/mg/kg/day)
Mn	2.4E-2/9.6E-4	--
Hg	1E-4	--

In accordance with the Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens, mutagenic ADAFs were used when calculating cancer risk for chromium and the PAHs (benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, dibenz[a,h]anthracene). An ADAF of 10 was applied for ages 0-2, 3 for ages 2-6 and 6-16, and 1 for ages 16-30.

Dermal absorption factors from soil were obtained from RAGS E and from Region III's Updated Dermal Exposure Assessment Guidance: 0.03 for arsenic, 0.01 for other metals, and 0.13 for the PAHs.

The risks are summarized on the following table:

Chemical	Child HI	Adult HI	Total CR
benz[a]anthracene	--	--	1E-6
benzo[a]pyrene	--	--	1E-5
benzo[b]fluoranthene	--	--	1E-6
dibenz[a,h]anthracene	--	--	1E-5
Al	0.3	0.03	--
Sb	0.2	0.03	--
As	0.2	0.02	1E-5
Cr	0.2	0.03	2E-4
Co	3	0.3	--
Fe	0.7	0.08	--
Mn	3	0.4	--
Hg	0.2	0.02	--
Total	8	0.9	2E-4

EPA's risk goals are for the total HI to be 1 or less, and for cancer risk to fall between (or below) the 1E-6 to 1E-4 risk range. Exceedances were driven by cobalt, manganese, and chromium. While the use of UCLs instead of maximum concentrations would lower the risk estimates somewhat, it still would not bring them within the acceptable range. However, these metals are common background constituents, and may be naturally occurring. Therefore, they were examined using the ProUCL 4.1 software, which allows hypothesis testing for background comparisons, as well as box plots, histograms, and Q-Q plots.

The range of chromium concentrations in the spray irrigation samples was 15 – 22.6 mg/kg, and the range in background soil was 18.1 – 24.4 mg/kg. Graphically, the concentrations do not appear significantly different; if there is any difference, it would be that site concentrations are lower than background.

The range of cobalt concentrations in the spray irrigation samples was 10.8 – 59.1 mg/kg, and the range in background soil was 12.2 - 26.7 mg/kg. Graphically, it appears that there may be a few hot spots at the upper end of the site range, but the 2-sided Wilcoxon Mann-Whitney test found no significant difference between the site and background means at $\alpha = 0.05$.

The range of manganese concentrations in the spray irrigation samples was 433 – 3700 mg/kg, and the range in background soil was 414 – 915 mg/kg. Graphically, it appears that there may be a few hot spots at the upper end of the site range, but the 2-sided Wilcoxon Mann-Whitney test found no significant difference between the site and background means at $\alpha = 0.05$.

References

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